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10/562,618	05/15/2006	Jan Boer	Boer 7-3-2-3	6192

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EXAMINER	
CASCA, FRED A	

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2617	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/562,618	BOER ET AL.	
	Examiner	Art Unit	
	FRED A. CASCA	2617	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *22 October 2009*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-34* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-34* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

1. This action is in response to applicant's amendment filed on October 22, 2009. Claims 1-34 are still pending in the present application. **This Action is made FINAL.**

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1-7, 10-16 and 21-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Li et al (US 2004/0022174 A1) in view of Sandell (US 2004/0131011 A1).

Referring to claim 1, Li discloses a method for transmitting one or more symbols in a wireless communication system (Par. 4 and 46), said method comprising the step of:

diagonally loading subcarriers from said one or more symbols in wireless communication system (Par. 46, 4 and Figures 1-4, note that diagonally loading is inherent in OFDM).

Li does not specifically disclose that the method is for a multi-antenna system and the loading is across a plurality of antennas in said multiple antenna as claimed.

Sandell discloses a MIMO-OFDM where the plurality of antennas form a diagonal channel matrix (Par. 41, abstract, and Fig. 1-7).

It would have been obvious to a person of ordinary skill in the art at the time of invention to modify the method of Li in the format claimed for the purpose of providing an efficient communication system.

Referring to claim 2, the combination of Li/Sandell disclose the method of claim 1, wherein said one or more symbols are long training symbols based on a single-antenna long training symbol and wherein each subsequent subcarrier from said single-antenna long training symbol is positioned in a long training symbol for a logically adjacent antenna (Li, Par. 4 and 46 and Fig. 1-4).

Referring to claim 3, the combination of Li/Sandell disclose the method of claim 2, wherein said single-antenna long training symbol is an 802.11 a/g long training symbol (Li, Par. 84).

Referring to claim 4, the combination of Li/Sandell disclose the method of claim 1, wherein said one or more symbols are short training symbols based on a single-antenna short training symbol and wherein each subsequent subcarrier from said single-antenna short training symbol is positioned in a short training symbol for a logically adjacent antenna (Li, Par. 4 and 46 and Fig. 1-4).

Referring to claim 5, the combination of Li/Sandell disclose the method of claim 4, wherein said single-antenna short training symbol is an 802.11 a/g short training symbol (Li, Par. 84).

Referring to claim 6, the combination of Li/Sandell discloses the method of claim 1, wherein said multiple antenna wireless communication system is a MIMO-OFDM system (Sandell, Par. 41).

Referring to claim 7, the combination of Li/Sandell discloses the method of claim 1, further comprising the step of inserting one or more additional subcarriers in at least one of said plurality of symbols (Li, Fig. 1-4 and Par. 4 and 46, note that inserting additional subcarriers is inherent in OFDM).

Referring to claim 10, the combination of Li/Sandell disclose the method of claim 2, wherein a reduced number of subcarriers are inserted in said at least one of said plurality of long training symbols and wherein a first long training symbol and a second long training symbol are interchanged to position at least one non-nulled subcarrier on at least one side of a hulled subcarrier (Li, Par. 4 and 46 and Fig. 1-4, Sandell, Par. 41).

Referring to claim 11, the combination of Li/Sandell disclose the method of claim 1, wherein said one or more symbols are a SIGNAL-field symbol (Par. 4 and 13, note that preamble and data fields are inherent in OFDM channel estimation).

Referring to claim 12, the combination of Li/Sandell discloses the method of claim 11, wherein said SIGNAL-field symbol includes a system type indicator (Par. 4 and 13, note that the preamble has system type information).

Referring to claim 13, the combination of Li/Sandell discloses the method of claim 2, wherein a number of said long training symbols is a function of the number of transmitters (Li, Par. 4 and 46 and Fig. 1-4).

Referring to claim 14, the combination of Li/Sandell discloses the method of claim 1, further comprising the steps of diagonally loading a remainder of a header of a packet across said logically adjacent antennas; and diagonally loading data sequences of said packet across said logically adjacent antennas (Li, Fig. 1-4, Par. 4 and 46, and Sandell, Par.41).

Referring to claim 15, the combination of Li/Sandell discloses the method of claim 1, wherein said plurality of antennas are logically adjacent (Sandell, Par. 41, note that in MIMO antennas are logically adjacent).

Referring to claim 16, the combo of Li/Sandell discloses the method of claim 1, whereby a lower order receiver can interpret said transmitted diagonally loaded symbols as a normal OFDM frame (Sandell, Par. 41 and Li, Fig. 1-4 and Par. 4 and 46, note both lower order and upper oder receivers can interpret and diagonally transmitted signal).

Claim 21-25 are analogous to the features of claim 1, 2, 6, 11 and 14, thus they are rejected for the same reason used in the rejection of claims 1, 2, 6, 11 and 14.

4. Claims 8, 17, 18 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Li et al (US 2004/0022174 A1) in view of Sandell (US 2004/0131011 A1) and further in view of Joo (US 2004/0208253 A1).

Referring to claim 8, the combination of Li/Sandell disclose the method of claim 7.

The above combination does not specifically disclose where said one or more additional subcarriers

are inserted to ensure that any subcarrier that was nulled by said diagonal loading is surrounded by subcarriers that are not nulled.

Joo discloses nulling subcarriers that are not diagonally loaded and inserting non-nulled subcarriers adjacent to nulled subcarriers (abstract and Par. 25).

It would have been obvious to a person of ordinary skill in the art at the time of invention to modify the method of Li in the format disclosed for the purpose of providing an efficient communication system.

Referring to claim 17, Li discloses a method for generating a plurality of long training symbols in a in a multiple antenna wireless communication system (Par. 4), said method comprising the step of:

diagonally loading subcarriers from a single-antenna long training symbol across long training symbols associated with logically adjacent antennas in said multiple antenna wireless communication system (Par. 4-5, note that diagonally loading subcarriers is inherent in OFDM. Further note that there is at least one transmitter and one receiver, thus a multiple antenna system);

Li does not specifically disclose that the method is for a multi-antenna system and the loading is across a plurality of antennas in said multiple antenna as claimed.

Sandell discloses a MIMO-OFDM where the plurality of antennas form a diagonal channel matrix (Par. 41, abstract, and Fig. 1-7).

It would have been obvious to a person of ordinary skill in the art at the time of invention to modify the method of Li in the format claimed for the purpose of providing an efficient communication system.

Li does not specifically disclose nulling subcarriers in said plurality of long training symbols that are not diagonally loaded; and

inserting at least one additional subcarrier to ensure that a nulled subcarrier has at least one subcarrier located on each side of said nulled subcarrier.

Joo discloses nulling subcarriers that are not diagonally loaded and inserting non-nulled subcarriers adjacent to nulled subcarriers (abstract and Par. 25).

It would have been obvious to a person of ordinary skill in the art at the time of invention to modify the method of Li in the format disclosed for the purpose of providing an efficient communication system.

Referring to claim 18, the combo of Li/Sandell/Joo discloses the method of claim 17, wherein said single-antenna long training symbol is an 802.11 a/g long training symbol (Li, Par. 84).

Referring to claim 20, the combo of Li/Sandell/Joo discloses the method of claim 17 and further disclose wherein a reduced number of subcarriers are inserted in at least one of said plurality of long training symbols and wherein a first long training symbol and a second long training symbol are interchanged to position at least one non-nulled subcarrier on at least one side of a nulled subcarrier (Joo, Par. 25).

It would have been obvious to a person of ordinary skill in the art at the time of invention to modify the method of Li in the format disclosed for the purpose of providing an efficient communication system.

Claims 26 and 27 are rejected for the same reason as claims 1 and 17.

Claim 28 is rejected for the same reason as claim 14.

Claims 29-30 are rejected for the same reasons as claims 17 and 14.

Claims 31-32 are rejected for the same reasons as claims 17 and 14.

Claims 33-34 are rejected for the same reasons as claims 17 and 14.

5. Claims 9 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Li et al (US 2004/0022174 A1) in view of Sandell (US 2004/0131011 A1) and further in view of well known prior art (MPEP 2144.03).

Referring to claim 19, the combo of Li/Sandell/Joo discloses the method of claim 17.

The combination does not specifically disclose where said at least one additional subcarrier allows nulled subcarriers to be estimated using an interpolation-based channel estimation technique.

Examiner takes official notice of the fact using an interpolation-based channel estimation is well known in the art.

It would have been obvious to a person of ordinary skill in the art at the time of invention to modify the above combination by using the well known interpolation technique for the purpose of providing an efficient communication system.

Claim 9 is rejected for the same reasons that claim 19 is rejected.

Response to Arguments

6. Applicant's arguments filed October 22, 2009 have been fully considered but they are not persuasive. In response to arguments that Li makes no reference to diagonal loading and that the combination of Li and Sandell does not disclose diagonal loading across multiple antennas, the examiner respectfully disagrees. The examiner asserts that diagonal loading of symbols is

inherent in OFDM channels and diagonal loading of symbols across multiple antennas is inherent in MIMO-OFDM channel. Reference Li teaches an OFDM system employing OFDM channels and reference Sandell teaches a MIMO-OFDM system. In providing evidence that an OFDM channel loads data symbols diagonally the applicant is referred to the chapter 3 of the text, Fundamental of Wireless Communication by David Tse (ISBN-13 978 0-521-84527-4), particularly section 3.4.4. Tse teaches that in OFDM a large bandwidth is divided into smaller (e.g., N) sub-bands, and then each sub-band is used in carrying a smaller portion of a large input data. Further, the smaller portions of the input data is being interleaved across the transmit and the receive antennae. This inherent interleaving function of OFDM is for maximizing channel capacity and eliminating crosstalk. Here, the interleaving function in OFDM is equivalent to diagonal loading of the claimed limitation. The examiner further refers the applicant to reference Terable et al. (U.S. Pub. No. 2007/02223364), particularly Par. [0119] in providing evidence that interleaving (equivalent to diagonal loading) is inherent in OFDM.

In response to arguments that Sandell does not disclose the diagonal loading across a plurality of multiple antennas in the multiple antenna wireless communication system, the examiner respectfully disagrees. Sandell, in figure 5 and paragraphs 98-108 clearly teaches a MIMO-OFDM system that displays multiple streams (sub-carriers) formed between multiple input and multiple output antennas. Further, a person of ordinary skill in the art would appreciate that in MIMO (Multiple Input Multiple Output) communication, (1) a channel matrix H is formed between the transmit antennas and the receive antennas, (2) that the channel matrix H is quantized into 3 sub-matrices by using the SVD technique, (3) that the SVD function takes channel matrix H as input and provides the matrices U, D, and V^H as outputs, (4) that the V^H

matrix is used in a pre-coding process, the U matrix is used in a post-coding process and the D matrix is used in the transmission, (5) that the D matrix is a diagonal matrix, and the U and V^H matrices are unitary matrices, (6) that the input data are fed into the D matrix, which is the channel matrix now, (7) and that since the D matrix is diagonal, where each diagonal element of the matrix is a sub-carrier, the input data are loaded into the sub-carriers diagonally. The applicant is referred to "Fundamental of Wireless Communication" by David Tse (ISBN-13 978 0-521-84527-4), particularly chapter 7 for the inherent details of MIMO and SVD. Based on the discussion above, the combination of Li and Sandell disclose every element of the claims.

Conclusion

7. **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Fred A. Casca whose telephone number is (571) 272-7918. The examiner can normally be reached on Monday through Friday from 9 to 5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Paul Harper, can be reached at (571) 272-7605. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/Fred A. Casca/

Examiner, Art Unit 2617

/VINCENT P. HARPER/

Supervisory Patent Examiner, Art Unit 2617